Rediscovering the Very First Italian Digital Computer

Hacking the Smaller Machine
(Hackerando la Macchina Ridotta)

Department of Computer Science
Museum of Computing Tools
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Contents

- **Historical research, hacker style**

- **A bit of history: ELEA 9003, CEP and MR**

- **MR fact sheet**

- **The rediscovering/rebuilding project**

- **Disseminating Computer Science**

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- **Hacker, the jargon definition**
  - **A person who enjoys exploring the details of programmable systems and how to stretch their capabilities, as opposed to most users, who prefer to learn only the minimum necessary**

- **Computer history, hacker style**
  - **Recover technical documentation**
  - **Study and deeply understand tech details**
 - **Check them with by-then current knowledge**

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The first Italian computers

- ## Olivetti ELEA 9003
  - ### Arithmetic ELectronic Elaborator
  - ### Fully transistorized, 1959 (prototype)
  - ### Commercially produced, 1960

- ## Calcolatrice Elettronica Pisana (CEP)
  - ### Pisa Electronic Computer, 1961
  - ### The best-known outcome of the 1955 project
  - ### By University of Pisa with Olivetti as partner

- ## Macchina Ridotta (MR)
  - ### Smaller Machine, 1957
  - ### First computer built by the CEP project
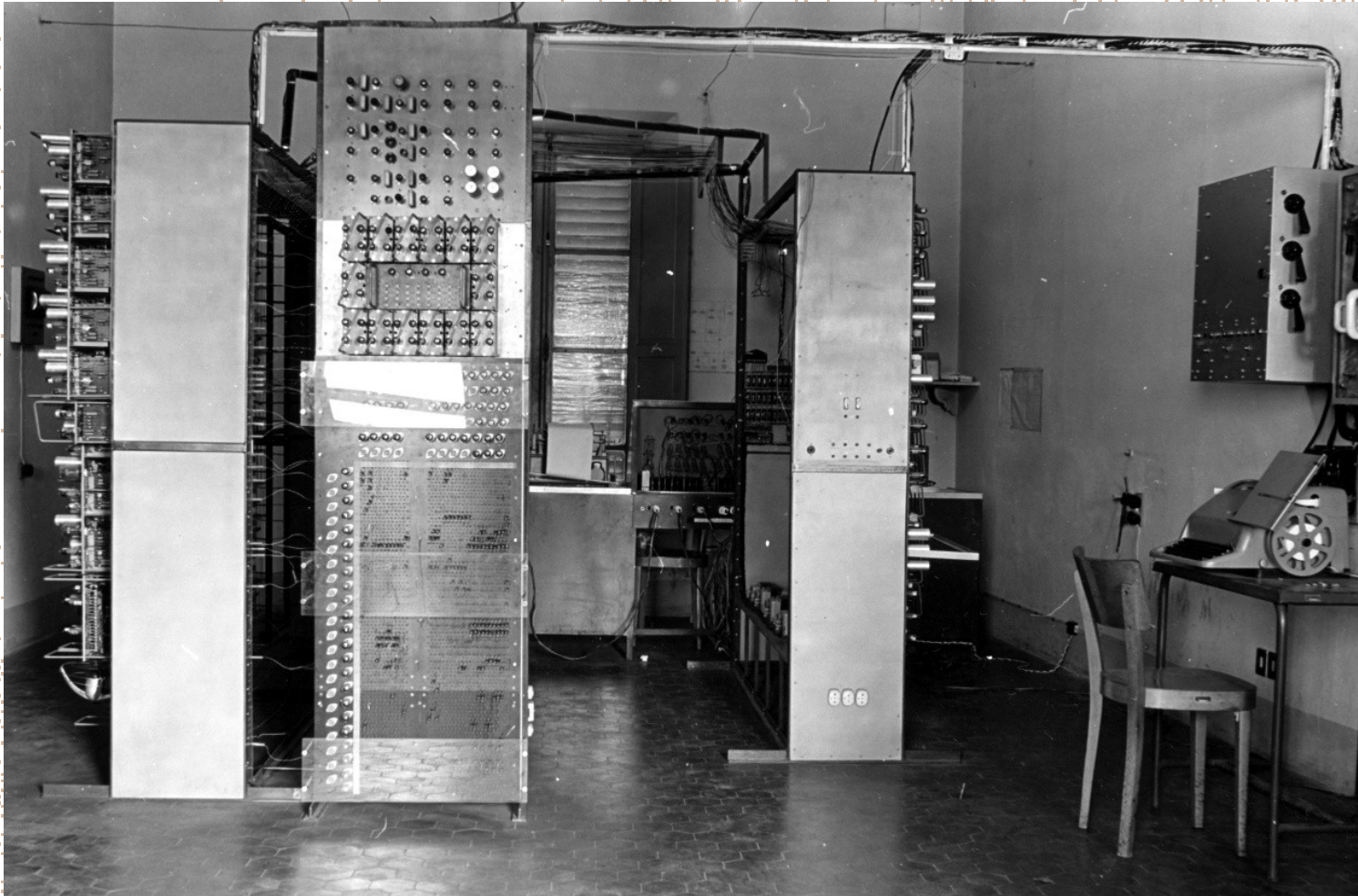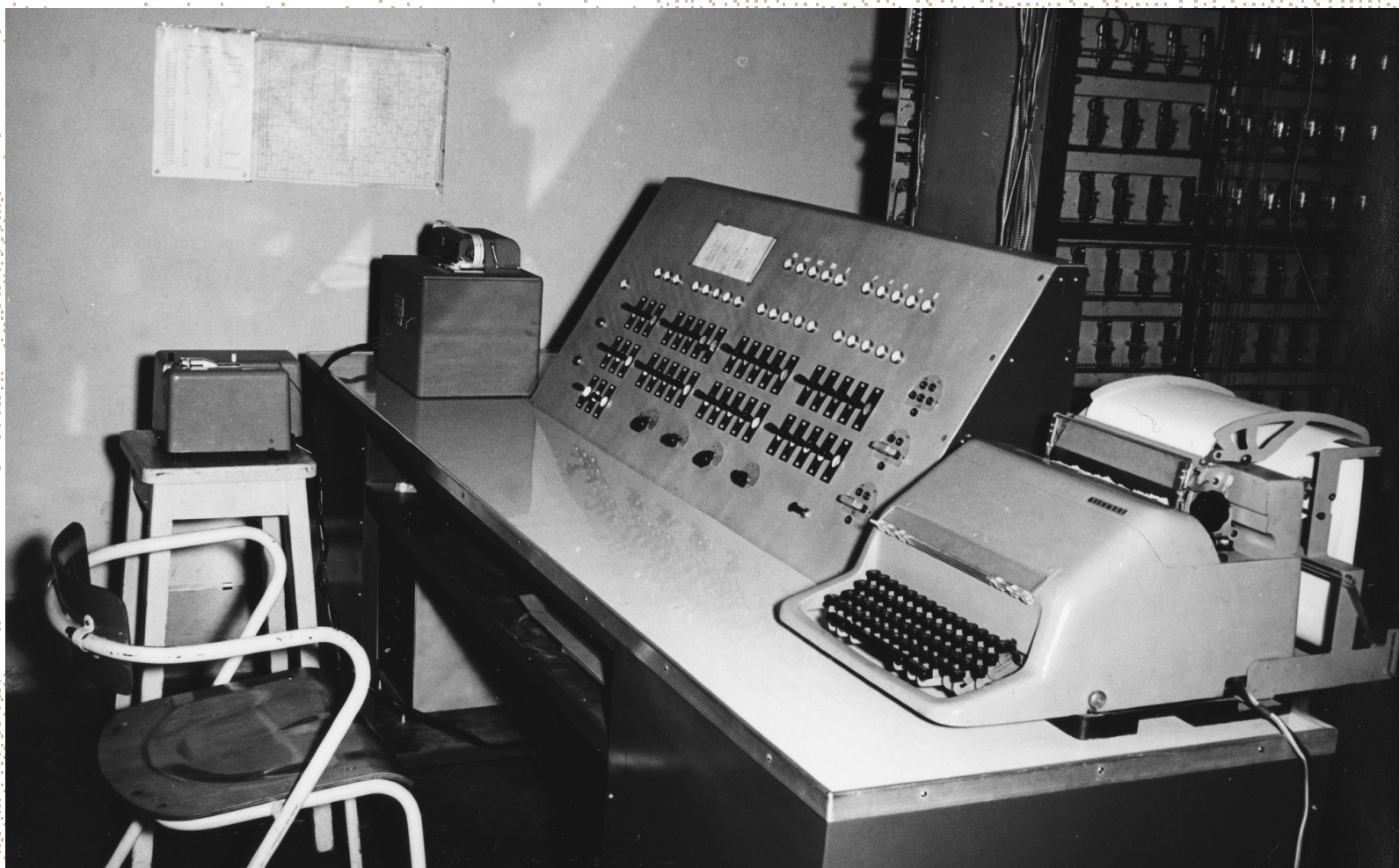 - ### Fully functional, used for computing services

The ELEA 9003, 1959

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The "ultimate" CEP, 1961

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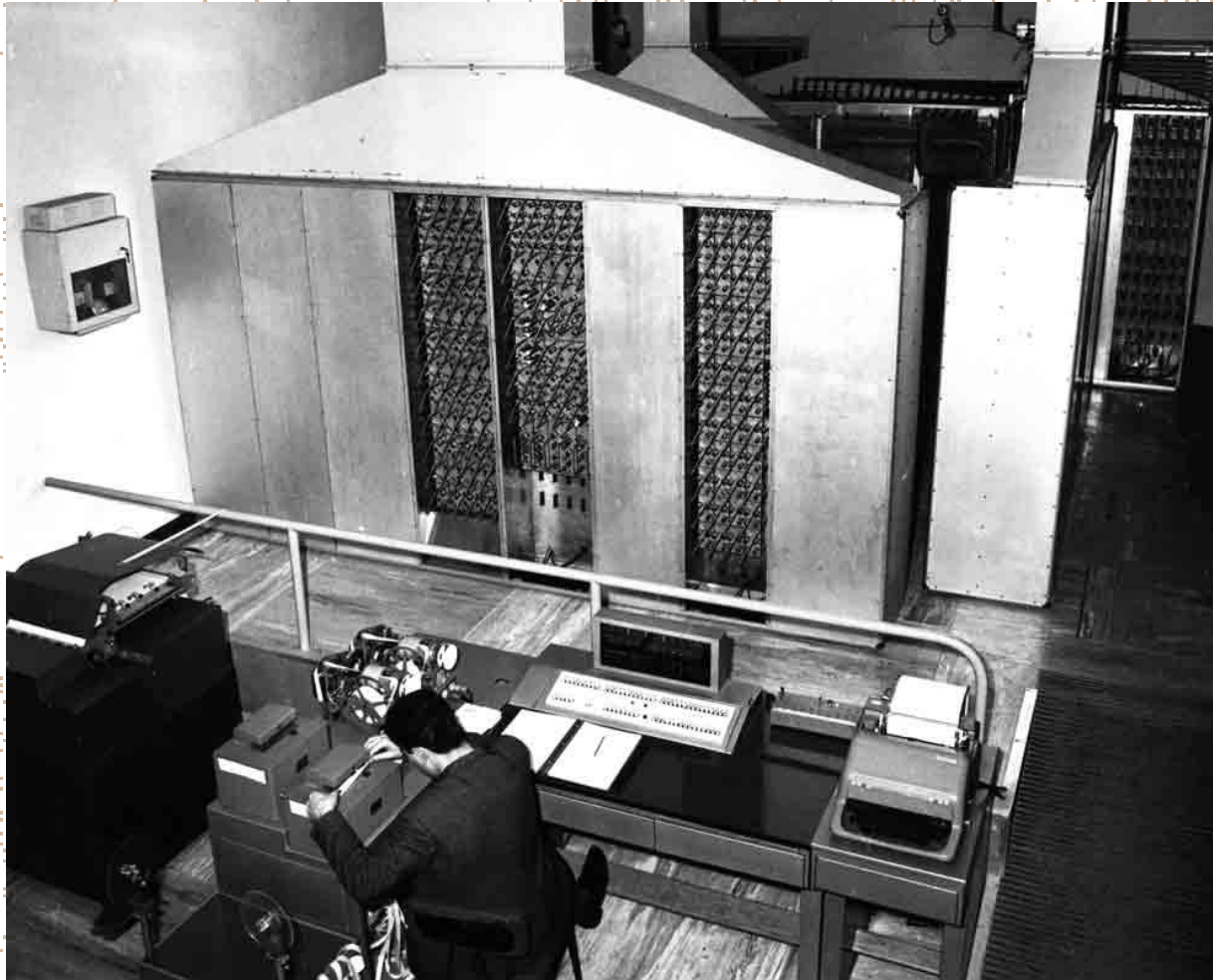
The MR, a lost machine

- **The MR has been so far underestimated**
  - Indeed, often plainly ignored
  - Previous research did not study MR technology
  - Focused mainly on administrative documents
  - Generally adopting a self-referential approach

- **Few facts may explain the MR oblivion**
  - People changed, memories vanished
  - The MR was dismantled, no physical relics
  - No inauguration ceremony, no media coverage
  - Misleading official plan (no prototype needed)

- **Digging the archives**
  - **A long treasure hunt started in 2006**
  - **Incomplete documentation**
  - **Tech reports, blueprints, admin stuff, notes…**
  - **All wildly shuffled**

- **Two versions of the MR**
  - **First design, July '56, probably only on paper**
  - **The actual MR, implemented one year later**
  - **Lot of rethinking, reworking and learning**
 - **A carefully thought design**

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- **Very first Italian built computer in 1957**
  - **Third to run, after CRC102A and Ferranti Mk1**
  - **1958 Olivetti "Macchina Zero" (in Pisa too)**
  - **1959 Olivetti ELEA 9002, Padova Booth APE**
  - **1960 First production ELEA 9003s**

- **MR characteristics**
  - **1024 x 18 bits words**
  - **4-8 mms variable clock (125-250 KHz)**
  - **2 punched tape readers**
  - **2 teletypes, keyboard in and paper/tape out**

State of the art solutions

- **Parallel architecture**
  - Many early 1950s machine processed word bits sequentially, MR used the parallel solution

- **Ferrite core memory**
  - Wrt other choices the MR was an early adopter of this soon to be standard solution

- **Microprogrammed control**
  - Adopting a MIT technology, the MR first implemented the idea proposed by EDSAC2

Other relevant features

- **Very high raw performance**
  - Compared to the Paris IBM 704, the MR had better KIPS (71.4, the 704 had Fortran, however)

- **Bootstrap in Direct Memory Access**
  - To boot the "MR OS" a memory image is read from punched tape in "DMA mode"

- **Hot breakpoints**
  - Programmers can set breakpoints which are activated by Control Panel keys

Rebuilding the MR: sims
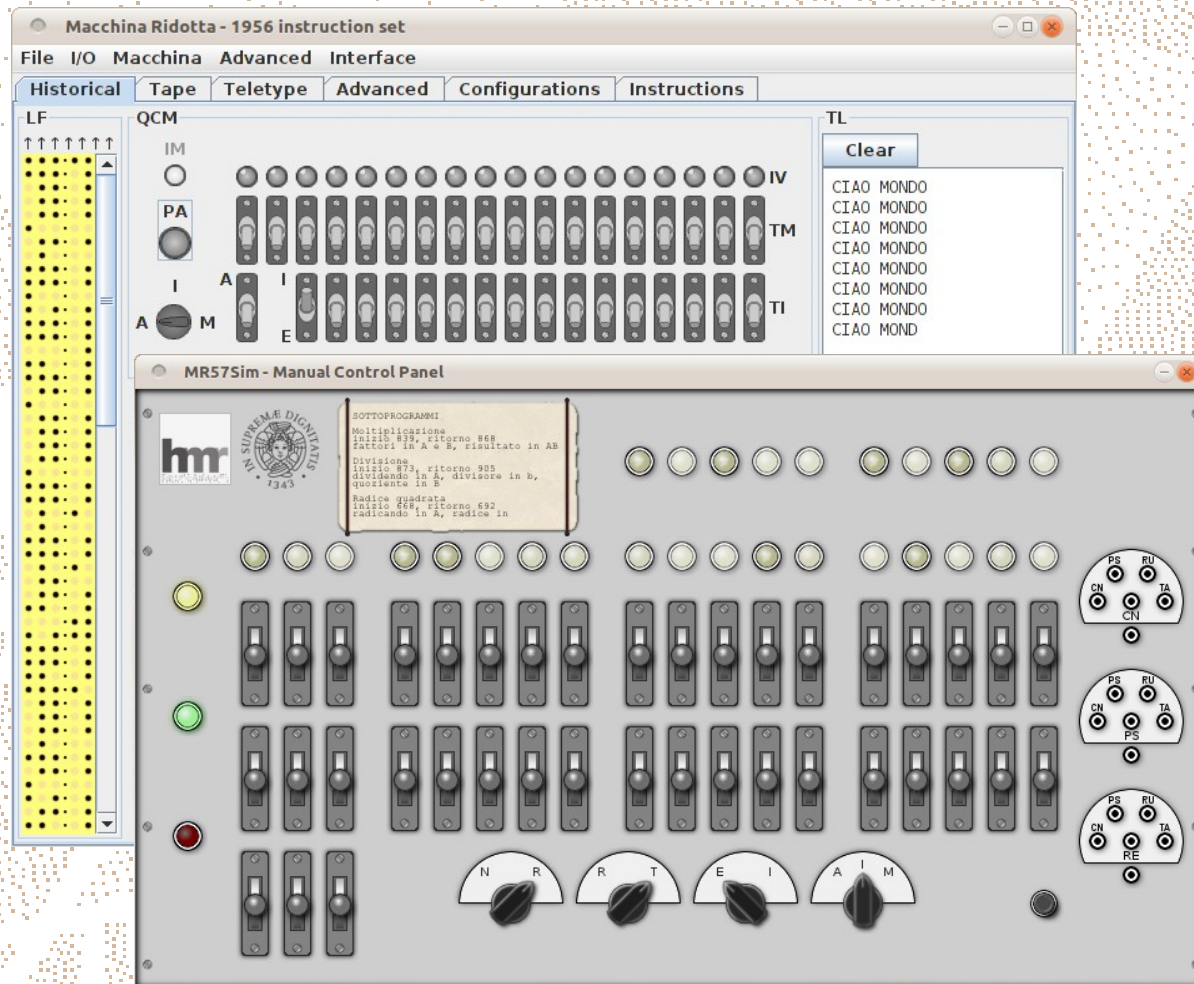
- **6 bits full adder, early 1956**
  - The very first piece of the very first computer :)
  - 1/3 of the MR adder, part of the machine ALU
  - Additions and subtractions in 2's complement
  - Rebuilt from original blueprints
  - Unsourced: very close to IBM 701 adder

- **A fine cooperation**
  - Computer Museum of Novara
  - National Institute for Nuclear Physics – Pisa

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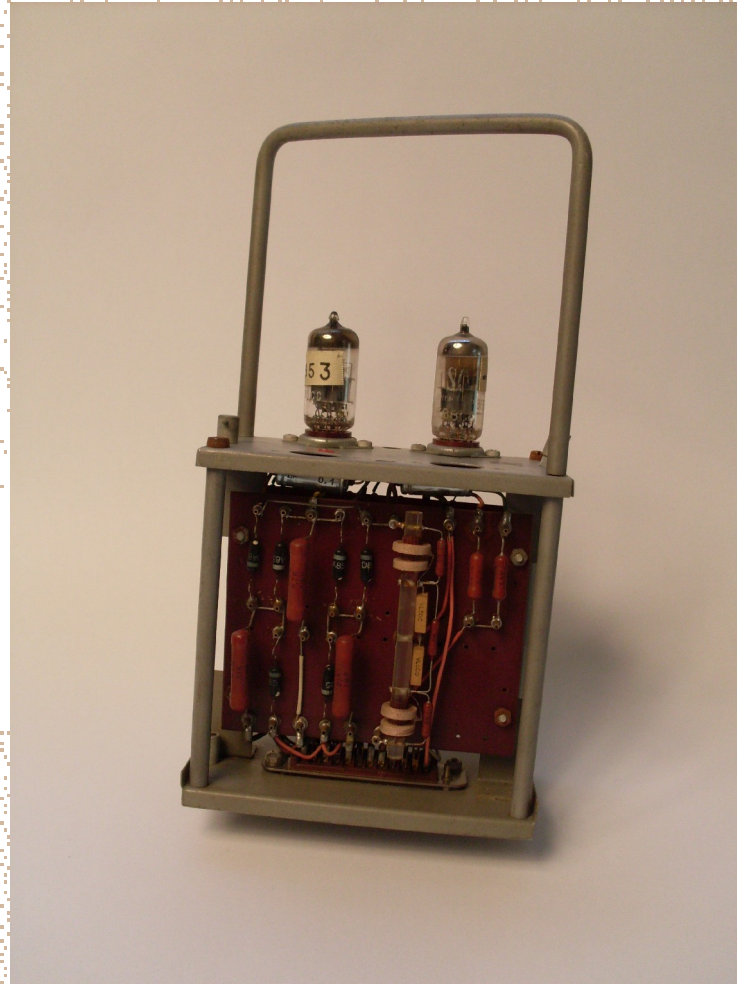
Teaching at the Museum

- **Museums must exhibit "alive" machines**
  - Computer are made to run
  - Half of Computer Science is software
  - Young people has no memories (nor nostalgia)

- **Goals**
  - Better understanding of how computers work
  - Re-enact the experiences of pioneers
  - Feel the progress of technologies
  - Challenge kids with demanding tasks

Binary exercises

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- **An experimental archeology project**
  - MR relevance was an unforeseen result
  - Thanks to in-depth technology understanding…
  - … needed by the rebuilding goals
  - A new chapter in the Italian computers history

- **Tools for teaching computer science**
  - Sims and replicas are used in teaching labs
  - Toys to make the Museum appealing
  - A fascinating way to show how hw & sw work